

Studies in Applying Machine Learning to LLRF & Resonance Control in Superconducting RF Cavities

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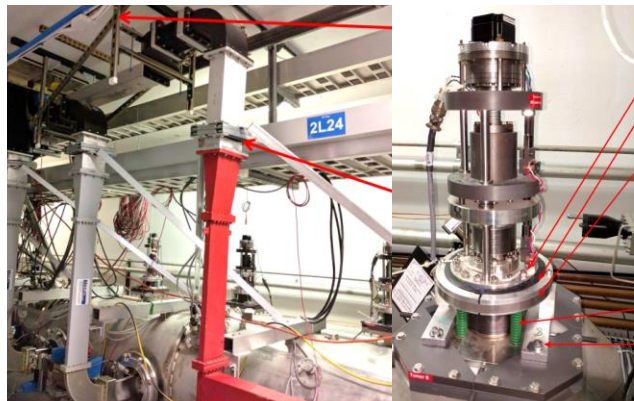
Chicago, October 1st 2019

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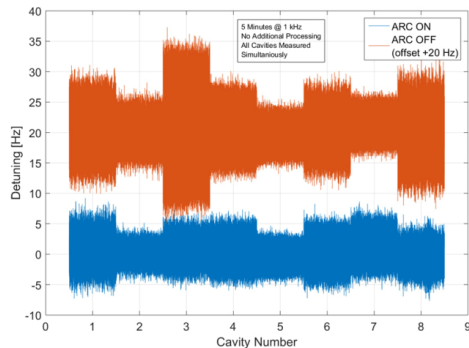
MOTIVATION

CEBAF C100 Hardening Waveguide Ceiling, strut bracing/damping and Tuner damping Ring



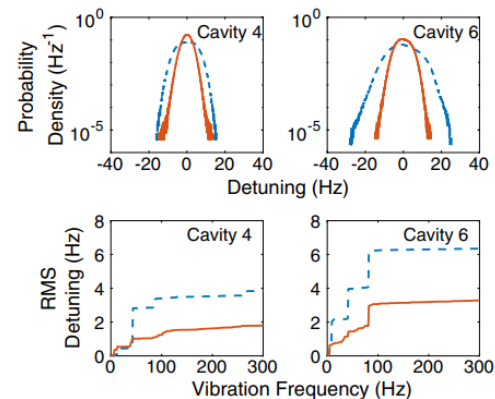
T. Powers. “Control of Microphonics for Narrow Control Bandwidth Cavities”. SRF 2017, Lanzhou

NCO and parallel, second-order IIR filters. ARC to characterize detuning spectrum and automatically generate filter bank coefficients

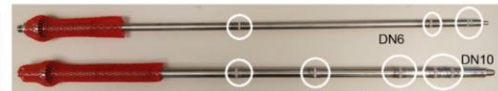
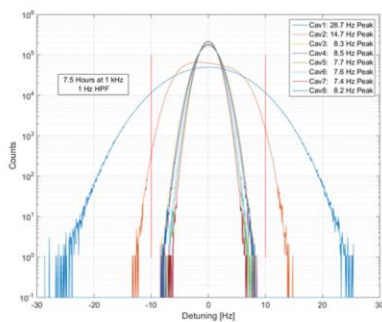


J.P. Holzbauer, et. al. “Active Microphonics Compensation for LCLS-II”. IPAC 2018, Vancouver.

Narrow Band ANC algorithm at Cornell-BNL ERL.



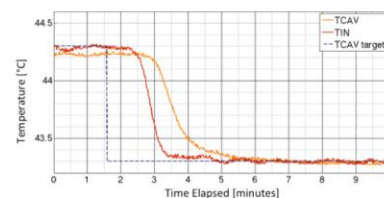
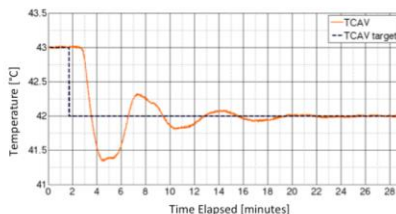
N. Banerjee, et. al. “Active suppression of microphonics detuning in high QL cavities”. PRAB May 2019.



Optimized valve stems with wipers added and valve re-plumbing

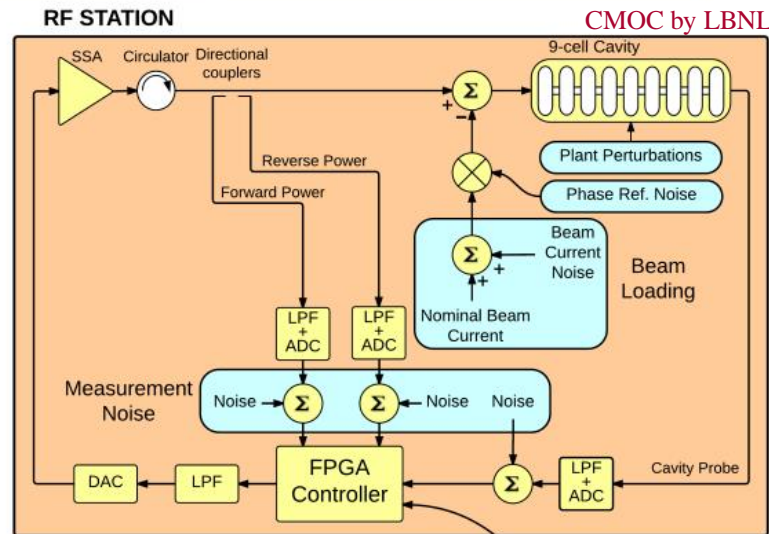
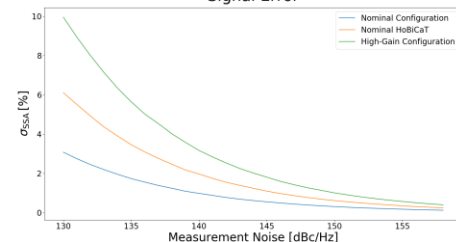
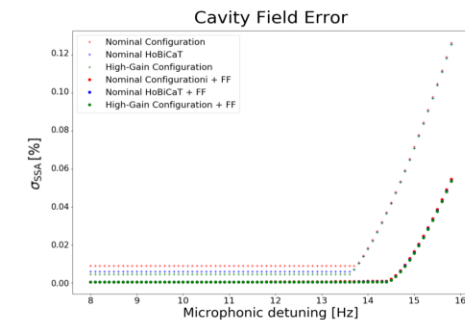
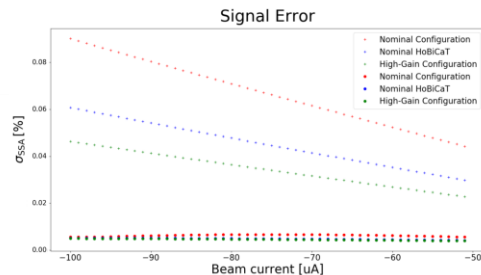
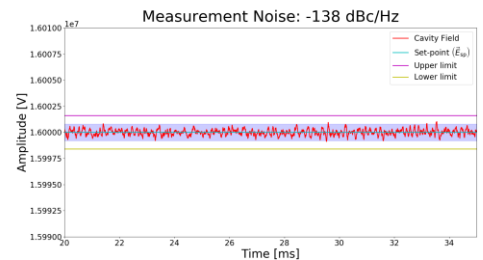
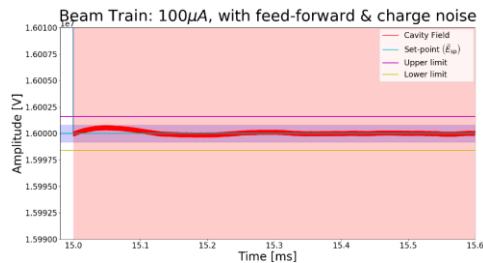
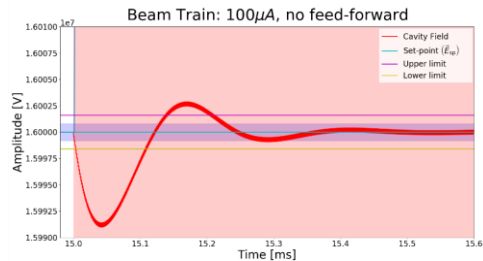
J.P. Holzbauer, et. al. “Passive microphonics mitigation During LCLS-II cryomodule testing at Fermilab”. IPAC 2018, Vancouver.

NN for temperature control of an RF electron gun at FAST

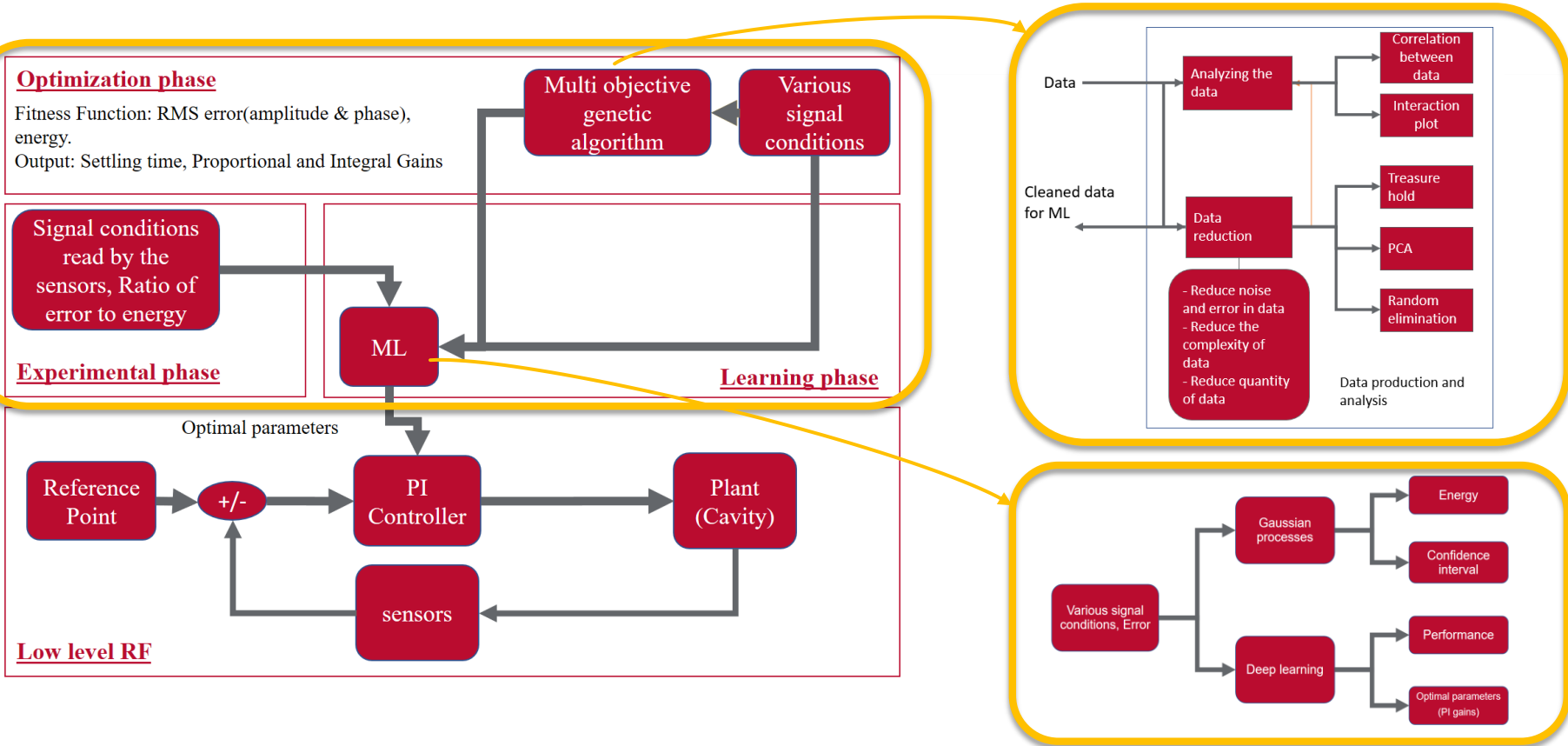


A. L. Edelen, et. al. “Neural Networks for Modeling and Control of Particle Accelerators”. IEEE Transactions on Nuclear Science, 20 April 2016

SIMULATIONS



ML ARCHITECTURE



References

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- [2] C. Serrano, L. Doolittle, C. Rivetta. *Modeling & Simulations*. LCLS-II LLRF Review. March 216.
- [3] *Performance and Functional requirements for the LCLS-II Low Level RF System*. LCLSII-2.7-FR-0371-R0
- [4] L. Doolittle, et.al. *LLRF Control of High QI Cavities for the LCLS-II*. IPAC 2016. Busan, Korea.
- [5] Pirayesh, R., Naseri, A., Moreu, F., Stochaj, S., Shah, N., & Krizmanic, J. (2019). *Attitude Control Optimization of a Two-CubeSat Virtual Telescope in a Highly Elliptical Orbit*. In *Space Operations: Inspiring Humankind's Future* (pp. 233-258). Springer, Cham.
- [6] Pirayesh, Reza, et al. *Deep learning and Gaussian process approach for optimal attitude control of a Two-CubeSat Virtual Telescope*. SmallSat 2019.
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Thank you for your attention!



Thanks to the LCLS-II LLRF team!

Poster Session #1
S1-26

